

Search for Narrow Positron Emission Lines in Heavy Ion Collisions with APEX

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Motivation

The apparent discovery of narrow positron emission lines in two separate experiments at the GSI, Darmstadt has been an object of intense investigation for nearly two decades. The signal reported in both singles and in other experiments with electrons detected in coincidence were taken as potential evidence for the decay of a new light neutral particle or other exotic phenomena. The APEX collaboration built a sensitive spectrometer at the ATLAS facility at Argonne to help discover the explanation for the surprising effect.¹

Experiment

During experimental runs in 1995 we searched for the previously reported effect in the reaction $^{238}\text{U} + ^{232}\text{Th}$ at 5.95 MeV/u and the reaction $^{238}\text{U} + ^{181}\text{Ta}$ at 5.95, 6.10 and 6.60 MeV/u. We searched the data for evidence of narrow structures in the positron singles spectrum and the positron-electron coincidence energy spectrum. Using analysis techniques motivated by the previous experiments we failed to find any effects consistent with the previous positive reports.² Figure 1 shows the electron-positron sum energy spectrum from the $^{238}\text{U} + ^{232}\text{Th}$ reaction with APEX and the resulting limits. Since the publication of this work, the EPOS experiment at GSI has reported that they have been unable to reproduce their previous findings with a more sensitive apparatus.

There are no plans to continue these searches at the present time. Other uses for the APEX spectrometer are under consideration.

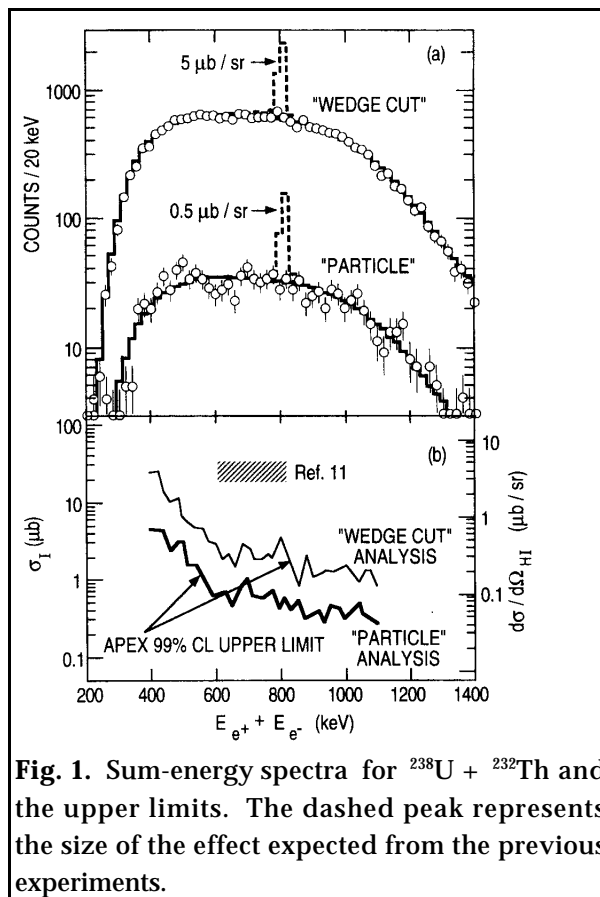


Fig. 1. Sum-energy spectra for $^{238}\text{U} + ^{232}\text{Th}$ and the upper limits. The dashed peak represents the size of the effect expected from the previous experiments.

Footnotes and References

The APEX collaborating institutions consist of: Argonne National Laboratory, Florida State University, Lawrence Berkeley National Laboratory, Michigan State University, Princeton University, Rochester University, University of Washington, and Yale University.

¹I. Ahmad, *et. al.* Nuclear Instruments and Methods A **370**, 539 (1996)

²I. Ahmad, *et. al.* Phys. Rev. Lett. **75**, 2658 (1995)